Siro KURITA*: Cytotaxonomy of Japanese *Coniogramme* Fée**

栗田子郎*: 日本産イワガネゼンマイ属の細胞分類学

(Pl. IV & V)

The genus *Coniogramme* is mainly distributed in subtropic regions of northern hemisphere. In Japan there have been two species with one variety of the genus, *C. intermedia* Hieron. and *C. japonica* (Thunb.) Diels with var. *Fauriei* (Hieron.) Tagawa. The first cytological studies on *Coniogramme* were made by Manton and Sledge (1954). They reported the chromosome number of two species, *C. sera* Fée (=*C. fraxinea* sensu Bedd.) from Ceylon and *C. japonica* (Thunb.) Diels grown at Kew, whose native origin was unknown. The former's chromosome number is 2n=ca120 and the latter's is n= 60. According to their results, they concluded that the basic chromosome number of *Coniogramme* is certainly 30. This conclusion has been confirmed by Mehra and Verma (1960) and Mehra (1961), who studied many species of the genus from Eastern Himalayas.

In the present investigations, I have examined three taxa of Japanese *Coniogramme*. The gametic chromosome numbers were counted at the first meiotic division of spore mother cells, which were fixed in 1:3 acetic-alcohol for about 24 hours or more. Preparations were made after Manton's method (Manton, 1950). While the somatic chromosome numbers were counted at the mitotic divisions of root-tip cells. Root-tips were immersed into the solution of 0.002 mol. 8-Hydroxyquinoline for 12 hours and fixed in 1:3 acetic-alcohol for about 12 hours. The materials were dehydrated in 1/10 N-HCl, keeping 60°C for 3 hours. Their preparations were made by squash method.

Coniogramme intermedia Hieron.

Materials were collected at Mitsumine, Saitama Pref., Mt. Amagi and Mt. Ogasa, Shizuoka Pref. Exactly 60 bivalent chromosomes were counted at diakinesis as shown in Pl. IV, 1 and in Fig. 1. Meiosis of the materials are completely normal and 16 spore mother cells in each sporangium give rise to 64 tetrahedral spores (Pl. IV, 3). These spores are normal and

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develop into normal gametophytes with both sexual organs, antheridia and archegonia. On the other hand, I found approximately 120 chromosomes at the metaphase of mitosis of root-tip cells (Pl. IV, 2 and Fig. 2). Mehra (1961) studied three species of the *C. intermedia* complex from Eastern Himalayas, and revealed the basic chromosome number of 30, and confirmed that all of those species are sexual diploid as shown in Tab. 1. I believed, therefore, the present species is a sexual tetraploid.

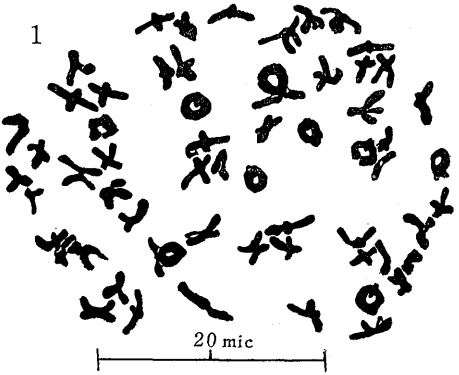

Fig. 1. *C. intermedia*, n=60.

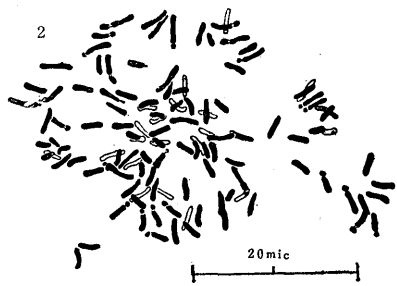

Fig. 2. 120 chromosomes in a root-tip cell of *C. intermedia*.

Coniogramme japonica (Thunb.) Diels.

Examined materials were collected at Mt. Ogasa and Mt. Amagi, Shizuoka Pref. The preparations, from which chromosome number was counted, were made by aceto-carmine squash method. Sixty bivalent chromosomes were undoubtedly observed in late diakinesis (Pl. V, 4 and Fig. 3). According to many observations of various phases of meiotic division, the present species seems to have perfectly normal alternation of nuclear phase. I confirmed also that the present species has 16 spore mother cells in each sporangium containing 64 tetrahedral spores, which develop into normal prothallia. Manton and Sledge (1954) who previously studied this species also reported the gametic chromosome number of 60.

Coniogramme japonica (Thunb.) Diels var. *Fauriei* (Hieron.) Tagawa.

This variety is somewhat rarer than other two species. Materials which

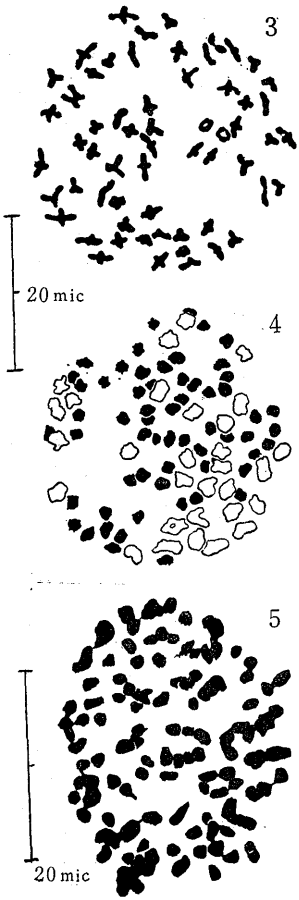

Fig. 3. *C. japonica*. n=60. Fig. 4. 90 chromosomes in a spore mother cell of *C. japonica* var. *Fauriei*. Chromosomes outlined may be bivalents. Fig. 5. Approximately 120 chromosomesin a spore mother cell of *C. japonica* var. *Fauriei*. Almost all chromosomes may be univalents.

were used in this study were collected at Ohbora valley, Shizuoka Pref., in summer of 1960 and they were cultivated in my garden. Cytological studies were performed next year and I found that the present species has abnormal process in meiosis as it was evident from a study of sporogenesis, namely the present variety has 16 spore mother cells in each sporangium, but they never produce normal spores. At the first meiotic metaphase, very diversified chromosome numbers have been observed. In some spore mother cells approximately 90 chromosomes were counted, and those consist of capable 30 larger chromosomes and capable 60 smaller chromosomes (Pl. V, 5 and Fig. 4). While in almost all of spore mother cells, approximately 120 chromosomes were observed (Fig. 5). Normal separation of chromosomes at anaphase I and second meiotic division, however, have never occurred so far as the materials examined at the present investigation are concerned. Mostly these chromosomes stick and change into a chromosome clump of irregular form. Ultimately such chromosome clump, or nucleus, die away and show no indications of cytokinesis. Therefore only sixteen spherical and abortive spores are formed (Pl. V, 6). In some cases, however, chromosomes which form equatorial plate separate into 2 or 3 groups, each of which organizes a nucleus (or a micronucleus), and these unclei often fuse with one another and organize one or two chromosome clumps. This fusing process looks like a figure of one stage of amitotic division as shown in (Pl. V, 7). Such spore mother cells give rise to dyads or triads (Pl. V, 8 and 9), all of which are also abortive. Unfortunately, I have no chance to observe the first prophase of meiosis in detail,

therefore I hesitate to affirm either both bivalents (from 0 to 30) and univalents (from 60 to 120) present or not in this species. But the chromosome constitution (karyotype) of (0–30 II+60–120 I) seems to be almost certain, because approximately 120 chromosomes have been counted in root-tip cells of the present species. This fact suggests that this variety is either a tetraploid hybrid between two different allo-tetraploid species or a tetraploid of structural hybrid. The former case, however, may have much probability.

Tab. 1. Chromosome numbers of *Coniogramme* Fée.

Species	Chromosome numbers	Worker	Locality
C. sera Fée	2n=120	Manton & Sledge (1954)	Ceylon
C. affinis Hieron.	n=30	Mehra & Verma (1960)	Eastern Himalayas
C. caudata (Wall.) Ching	n=30	Verma (1961)	——
C. fraxinea (Don) Diels	n=30	——	——
—var. *denticuloserrulata* Hieron.	n=60	——	——
—var. *denticuloserrulata* (hybrid)	3n=90 (90 I)	——	——
C. indica Fée (aff. *intermedia*) (hybrid)	3n=90 (30 II+30 I)	——	——
C. intermedia var. *glabra* Ching f. α and f. β.	n=30	——	——
—var. *villosa* Ching (?)	n=30	——	——
C. procera (Wall.) Fée	n=30	——	——
C. intermedia Hieron.	n=60, 2n=120	Kurita	Japan
C. japonica (Thunb.) Diels	n=60	Manton & Sledge (1954)	?
——	n=60	Kurita	Japan
—var. *Fauriei* (Hieron.) Tagawa	2n= ca 120 (0–30 II +60–120 I)	——	——

Summary

Chromosome numbers of two species with one variety of the genus *Conio-*

gramme have been counted. *C. intermedia* and *C. japonica* are sexually reproducting tetraploids. While *C. japonica* var. *Fauriei* is a tetraploid hybrid or a tetraploid of structural hybrid. The present investigations have reconfirmed previous data (Manton and Sledge 1954, Mehra and Verma 1960 and Mehra 1961). The results are summarized in Tab. 1.

I am grateful to Dr. M. Nishida, Assist. Prof. of Chiba University, for his guidance and encouragements. I am also thankful to Dr. H. Ito, Prof. of Tokyo University of Education, for the identifications of the materials.

References

1) Manton, I. and Sledge, W.A. 1954. Phil. Tr. Soc. London, B. **238**; 127–185. 2) Manton, I. 1950. Problems of cytology and evolution of the Pteridophyta. Camb. Uuiv. Press. 3) Mehra, P. N. and Verma, S. C. 1960. Caryologia **13**: 619–650. 4) Mehra, P. N. 1961. Res. Bull. Panjab Univ. (N. S.), **12** (parts I–II): 139–164. 5) Tagawa, M. 1959. Coloured Illustrations of the Japanese pteridophyte. Hoikusha, Osaka.

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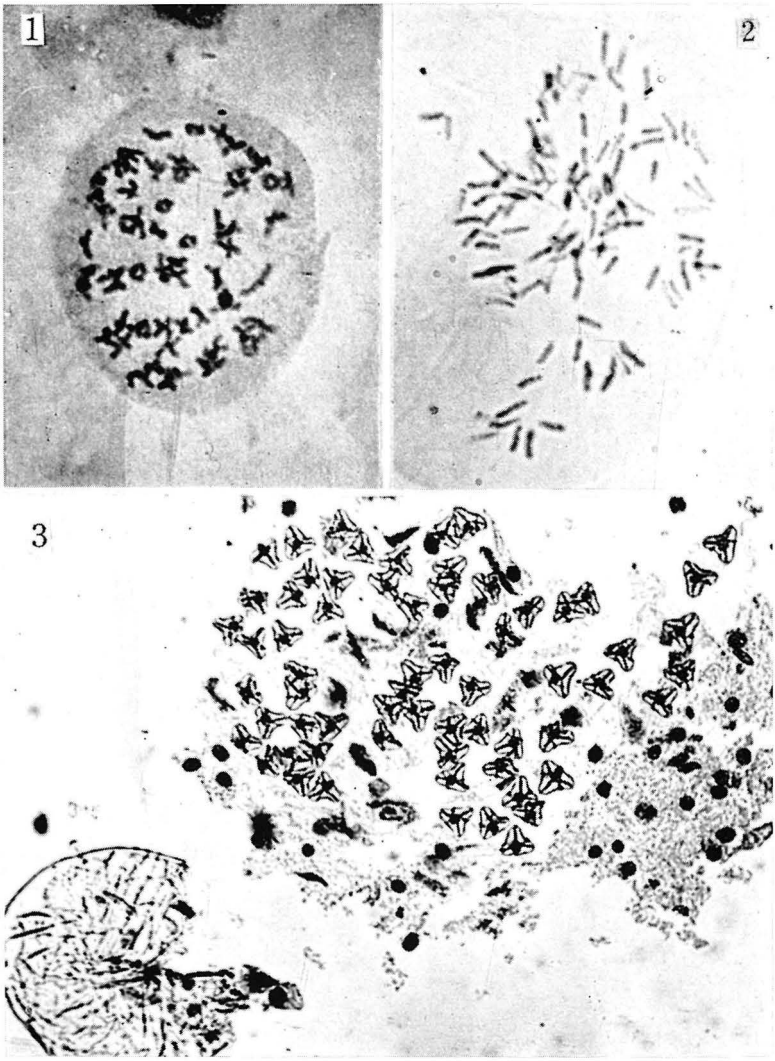
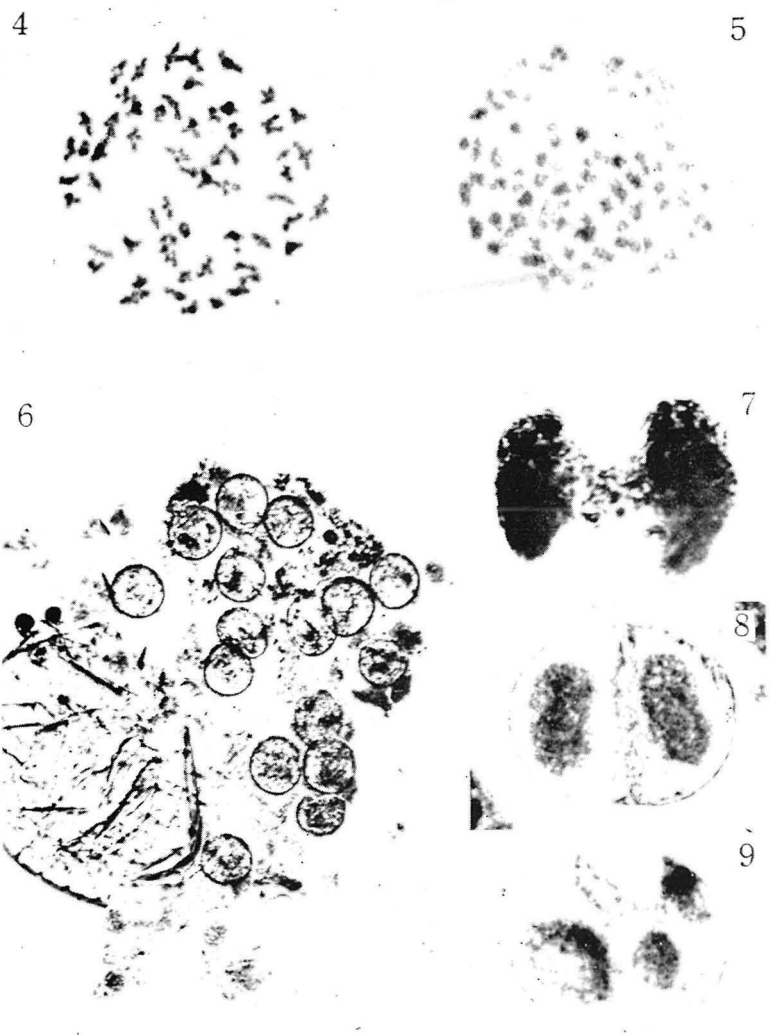
イワガネソウは n=60, イワガネゼンマイは n=60, 2n=120 で，両者とも胞子形成過程は正常である。したがってこの面から両種を区別することは出来ない。しかしイヌイワガネソウは前種と異っている。すなわち，2n=ca 120 ではあるが第 1 減数分裂中期に於て約 60～120 の一価染色体と 0～30 の二価染色体とが現れ胞子母細胞は不規則に分裂する。その結果形成される胞子は成熟することなく消滅する。このことよりイヌイワガネソウは n=60 の染色体数を持つ二種間の雑種か，さもなければ構造雑種であろうと考えられる。

□ Syo Kurokawa: **A monograph of the genus Anaptychia,** 115 pp., 9 pl., Beih. zur Nova Hedwigia 6 (1962) ゲジゲジゴケ属の世界のモノグラフが国立科学博物館の黒川道氏の手によって完成し，このたびドイツで出版された。Vainio の *Cladonia* や Motyka の *Usnea* のモノグラフに比べれば小粒ではあるが，世界のモノグラフが日本人の手によってでき上ったことは喜ばしい。ゲジゲジゴケ属地衣についての認識はいままで極めてあいまいで種の同定にも誤りが多かったが，この論文によって，本属の分類が確立されたといってもよい。著者は胞子の形態を重視して，本属を二つの大きな Section に分類し，各 Section に更にいくつかの Series を設ける分類系を提案した。取扱われた種類は 79 種・22 変種・24 品種に達し，このうち 33 種・4 変種・5 品種は著者によって設立されたものである。この他にも多くの新知見が盛られていて，多数の学名の変更も見られる。文献の引用法にも配慮が見られ，また，記載文や各種についての論議も簡潔にまとめられている。モノグラフを手がけようとする者にとってよき指針ともなると考える。J. Cramer (P. O. Box 166, Weinheim / Bergstr., West Germany) 発行。定価 $10 (DM 40)。 (朝比奈 泰彦)



1. Sixty bivalent chromosomes at late diakinesis of *Coniogramme intermedia*. 2. Approximately 120 chromosomes in a root-tip cell of *C. intermedia*. 3. Sixty four young tetrahedral spores of *C. intermedia*.



4. Sixty bivalent chromosomes at late diakinesis of *C. japonica*. 5. Approximately 90 chromosomes at metaphase of *C. japonica* var *Fauriei*. The constitution of these chromosomes may be (30 II+90 I). 6. Sixteen abnormal spores of *C. japonica* var. *Fauriei*. 7. Pseudoamitosis between two daughter nuclei in a spore mother cell of *C. japonica* var. *Fauriei*. 8. Abnormal dyad of the same species. 9. A triad of the same species.